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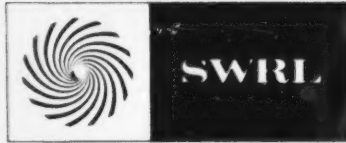
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ABSTRACT

The conditions whereby a concept might be learned on the basis of a language mediation process prior to the inductive learning of subordinate concepts are sketched. The view is expressed that grammar treatments which are apt to primary education should be defined on the basis of a pedagogy's needs for linguistic characterizations of concepts to be learned during primary education. Grammar is viewed as appropriate to the extent that it aids the child to decode linguistic characterizations to extralinguistic meaning. The bulk of the paper is taken up with a discussion of the conditions under which a child might be expected to learn a new concept strictly on the basis of past experience and language mediation effects.
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LANGUAGE-MEDIATED CONCEPT LEARNING

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ABSTRACT

The conditions whereby a concept might be learned on the basis of a language mediation process referencing to the prior inductive learning of subordinate concepts are sketched. The view is expressed that grammar treatments apt to primary education should be defined on a pedagogy's needs for linguistic characterizations of concepts to be learned during primary education. Grammar is viewed as appropriate to the extent that it aids the child to decode linguistic characterizations to extra-linguistic meaning.

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LANGUAGE-MEDIATED CONCEPT LEARNING

The notion that language mediates learning is no doubt apt. That is, a formal system of concepts and rules, suitably constructed and interpreted, can be used to assign real-world meanings to statements referring to phenomena in an empirical universe of discourse. Perhaps all that is wrong with the language mediation notion is that it is presently no more than trivially explicit. If the problem is to design instruction that more fully exploits language-mediated learning, then the first task is to better structure what language mediation signifies.

The situation is analogous to that for agriculture during a prescientific era. Long before the findings of soils chemistry and allied sciences were available to the farmer, it was known that certain fertilizing treatments of the soil were beneficial to crop production. The practices of spreading manure, placing animal carcasses just beneath the surface, and slash-and-burn date back to antiquity. The farmer of the prescientific era was unaware of the particular deficiencies he sought to correct--e.g., nitrogen, phosphorous, potash, trace elements--and so in no position even to ask how such deficiencies might best be remedied. Yet the "fertilizing process" demonstrably was a part of the solution to a crop-optimization objective long before the agrisciences emerged. Today the agrisciences are well-developed and we speak of an agricultural revolution. Crop yields have increased twenty-five fold during the last century and the end is not in sight. This is due primarily to the fact that the agrisciences have taken farming beyond the tenable but imprecise and inefficient notion that a fertilizing process must intervene between a harvest and a next planting to insure an "abundance" at next harvest.

A century or two ago society left it to the farm community to determine the conditions that would optimize crop production. Today society allows a speech community to determine how language optimally will mediate learning. Were there no recourse to assigning such work to "communities," it seems tenable that one could expect better performance from a farming community than from a speech community. A farming community at least consists of individuals who know what output is required and what their stake is in increasing output. However, if speech communities are communities at all, their members are woefully unaware of any requirement to upgrade learning by upgrading the relation of the language system to such learning.

The potentially apt communities to that task are the scholarly community and the educational R&D community. Thus far, the scholarly community has been content merely to label the process whereby language mediates learning referencing to a nonlinguistic universe of discourse. The educational R&D community, seeing little that could be exploited in consequence of accepting the process label, has tended to stand aloof from the language mediation question. The classrooms of contemporary primary education abound with evidence that teachers and textbook writers believe that language-mediated learning is central to education. Many outside the classroom share that belief. Yet systematic attempts to place language mediation on a technological footing are hardly a common endeavor in scholarly and educational R&D settings.

We learned long ago that Latin and the other "mental disciplines" have little if any positive effect on the acquisition of skills that schools are funded to instill in children. There is a tendency in the literature to "prove" this now for grammar. Grammar taught as such--the linguistic system qua system--well may warrant such a conclusion. However, the notion of language-mediated learning suggests another approach to grammar, that of serving the needs of a language-mediated learning of concepts and rules whose domain is nonlinguistic or, the positivists ignored, real-world.

In Principia Mathematica, Whitehead and Russell succeeded in showing that the formal domains of mathematics and logic are essentially isomorphic. It appears tenable that any who saw fit to do so could show that there is a portion of the domain of linguistics that is isomorphic with mathematics and logic. However, linguistics is a wealthier universe of discourse than are mathematics and logic. The formal system of linguistics permits us to deal with real-world events that logic and mathematics cannot yet deal well with--e.g., events referencing to volition. The systems of logic and mathematics offer more precise bases than does linguistics for mediating the learning of many real-world concepts, rules, and strategies. It seems tenable that the linguistic system remains in the running for two reasons: a) its greater popularity in the speech community or larger society and b) its greater applicability to an understanding of real-world phenomena. That a formalization of a linguistic system is less further advanced than are those for logic and mathematics should not stand in the way of making use of whatever first-approximation to such a formalization is available or can be constructed. Education already makes widespread use of the system, as intuitively perceived. Surely scholars can provide a more explicit framework now.

The rest of the paper will deal with the conditions under which a child might be expected to learn a new concept C strictly on the basis of past experience and language mediation effects. Let C be a real-world concept. One might not ever wish to teach C without, at some point in the instruction, going directly to its real-world domain. The illustrative treatment does so only to show that a language-mediated approach is both feasible and preliminarily understood. Few would argue that new concepts (or rules or strategems) should be taught entirely on the basis of language-mediated effects of suitable past experience. The illustration to be presented only reflects that the antecedents to effective language-mediated learning are not so mysterious as the literature sometimes suggests. The notion is congruent with emphasizing the linguistic system as a pedagogical device as a strict function of the system's aptness to optimizing (language-mediated) instruction regarding real-world phenomena.

Preliminaries

Oversimply perhaps, we begin by postulating linguistic and real-world universes of discourse. The phenomena of the linguistic universe are postulated to include linguistic names (e.g., the word triangle), concepts (e.g., form class), rules (e.g., " N_1 Vs N_2 is equivalent to N_2 is Ved by N_1 "), and strategems. Those of a real-world universe are postulated to include real-world items (e.g., a triangle), concepts (e.g., triangles), states and processes that are described by rules that relate concepts (e.g., "Positively-charged bodies repel; oppositely-charged bodies attract"), and strategems that indicate how a set of rules will be negotiated. The two universes are considered mutually exclusive but complementary; taken together, they are viewed as exhausting the domain of all phenomena that will have educational significance. The postulated dual systems are thought to be consonant with and perhaps defined by existing semantic theory.

It is assumed that the linguistic system's resources are such that its inventory of lexical constructions either does or could include an item that can be used to name each concept, rule, or strategem of the real-world universe or any item exemplarizing any such phenomenon. This is essentially an anti-Whorfian view of the linguistic system. Such systems are sufficiently versatile to serve all present and future needs of man because they contain a basis for evolving to meet changed conditions.

When the educational process in some fashion shows the domain of a real-world concept and specifies how the concept will be named in the linguistic universe, then the name of that concept is real-world interpreted. When a band of properly-credentialled individuals agree to assign such a name to a concept that is exemplarized in a real-world domain, the name becomes conventionally interpreted. When a child exposed to the educational process sketched above learns an exemplar of the conventional interpretation, then the name is learner-interpreted. Hereafter, an interpreted lexical construction will be one that is learner-interpreted consonant with educational objectives.

The name of a real-world concept is a lexical construction. The structure of such constructions will vary. At one extreme of structure is the single free morpheme--e.g., dog. It is not clear what degree of complexity should be taken as the upper bound for lexical constructions. Dictionaries tend to lexiconize constructions through noun phrases. Many such entries involve nominalizations--e.g., of verb phrases--reflecting a particular bias of lexicographers. For present purposes, the upper bound will be taken as characterized by phrase structure.

The homonyms of a lexicon name different concepts; thus, dog (n.) and dog (v.) name different real-world concepts. If the concept of synonymity has any true exemplars, then the set of such exemplars are members of a base form class. We might interpret such a class as a linguistic concept of a name of a real-world concept. We need not

consider synonymity at the word level further. However, it is possible that synonymity most applies at the phrase level--e.g., plane triangle, triangle existing in two-dimensional space. Whenever the linguistic name of a real-world concept has alternative forms, then any one of these forms exemplarizes the name and the linguistic system provides a basis for reaching any other exemplar of that name.

The 2D concept of plane triangles is named by a lexical construction whose linguistic form class designation is inanimate count noun (N_{ci}). If one understands the conventional interpretation of N_{ci} , then knowing no more about the real-world concept of plane triangles than that its name classifies linguistically as N_{ci} conveys some information concerning what the concept is and is not in the real-world domain. While it would be possible to construct a formal system none of whose phenomena had any such conventional interpretation referencing to a real-world domain, the linguistic system is not of that type, which is why we are interested in it. Real-world plane triangularization is a 4D concept, signifying something like "to make or reduce to the shape of a plane triangle." The base form of plane triangularization might appear as a verb phrase--something on the order of $V_t + N_{ci}$. There exists in the linguistic system a set of transformational rules whereby one can get from the name of a concept like that of plane triangles to the name of a concept like that of plane triangularization. Whether or when such an "element of grammar" should be taught probably will depend on characteristics of the set of real-world concepts that the schools must teach.¹

Real-world concepts have class status; the concept is an abstraction of membership in the class. The plural concept of linguistics reflects class status of real-world concepts. An item exemplarizing a real-world concept is a member of the class. Item status is reflected by the linguistic system in various ways--e.g., by the indefinite article when the name of the real-world concept is a noun and the reference is to any exemplar of the concept. Many linguistic concepts have conventional real-world interpretations; some of these the child learns before coming to school.²

¹Perhaps one day the evidence will be in that system qua system training best prepares all children to learn how other--e.g., real-world--systems are organized. Until such evidence is at hand, one would teach linguistics qua linguistics only to those children who elect to become linguists at an early age (and mathematics qua mathematics only to similar populations). This does not argue, of course, that many characteristics of the linguistic system should not be taught in the primary grades. Rather, it argues that such characteristics should be made a consequence of related characteristics of those domains that are most central to primary education.

²All statements made herein concerning how characteristics of a linguistic system relate to a real-world domain have a lay status--satisfactory for illustrative purposes but not good enough for anything else.

If the child interprets certain linguistic concepts conventionally and if he receives extralinguistic instruction referencing to suitable prerequisite real-world concepts and learns how these concepts are named, then the schools should be able to interpret certain other real-world concepts to him without leaving a linguistic universe of discourse. This the schools attempt to do, perhaps sometimes too enthusiastically. Below, this language-mediated learning process is explored using the concepts of a linguistic usage and a linguistic characterization of a concept C.

A pure differentiation of a usage and a characterization conceivably would define the former as not naming any attribute of C and the latter as naming one or more attributes and, if warranted, one or more relations holding between attributes. Pedagogical practice suggests that a somewhat less pure distinction between usages and characterizations should be employed. Assume a linguistic characterization scale which conveys minimal information about a concept by naming one of the concept's interpreted attributes and maximal information by formally defining the concept in terms of its interpreted related attributes. Practice suggests that a usage should classify at the minimal-information end of such a scale. Remarks that follow will so interpret a usage.

Linguistic Usage

Consider a larger construction having linguistic significance--e.g., a "sentence." Such a construction might name any number of interpreted attributes of a concept. If the larger construction consists of an uninterpreted lexical construction that names a concept of interest and one or more interpreted lexical constructions, no more than one of which names an attribute of the concept of interest, then the larger construction is a linguistic usage. An implication of this definition is that the usage may provide information concerning an attribute of the concept at two or more levels of a conceptual hierarchy--to be illustrated. Thus, "no more than one attribute-naming construction" signifies no more than one at each hierarchical level considered, where any name used at a lower level is subsumed by a name at the next-higher level. (If no more than one attribute can be named at any level, then no relation between same-level attributes of a concept can be named either.)

Assume that the child has, in consequence of appropriate linguistic and extralinguistic instruction, induced the linguistic concept animate noun (which instruction causes him to name animals; the shared name for a real-world concept and a corresponding linguistic concept that subsumes the names of all real-world concepts that are subordinate to the concept of animals). The child has the interpreted name animals, referencing both to a linguistic and to a real-world concept, and the interpreted names people, horses, dogs, etc., which refer to concepts that instruction has made subordinate to the concept of animals. Moreover, the child makes use of linguistic concepts and rules whereby sentences of the form "N_{ca} +

V = kiss + N" are accepted and those of the form "N_{ci} or N_m + V = kiss + N" are rejected. That is, he will accept sentences on the order of "The horse kissed the slipper" but not "The slipper kissed the horse."³

Against this background is introduced the name zot, which references to a real world concept of zots. Let the key to the real-world significance of the concept be the linguistic usage "A zot kissed a slipper." It is assumed a) that kissed and slipper are interpreted concepts and b) that the child's experience warrants the view that slipper-kissing is a low probability manifestation of kissing behavior. What does the usage signify concerning zots?

First, the indefinite article reflects that there is a class of zots, of which "a zot" is only one member. Second, the interpreted kiss tells the child that zots belong to the class of kissers and so to the larger class of animals. Finally, the usage suggests that zots are somewhat unusual, since slipper-kissing is not very probable. To recapitulate across hierarchical levels, the usage suggests that zots belong to the slipper-kissing subclass of the kissing subclass of the animal class. The usage says something about zots but it does not characterize them very well.

One attraction of the linguistic usage is that many exemplars may be used. One need not be confined to a single usage when seeking to convey information about zots. So long as the non-C names of each usage are interpreted and the usage names no more than one attribute at any level, the number of usages that may be employed is constrained only by the number of zot characteristics that are of interest and pedagogical efficiency considerations. More could be conveyed about zots using additional exemplars having the same sentence form--e.g., "Zots climb trees," "Zots eat bananas," "Zots use clubs." But it is not necessary to employ just one sentence form. Any sentence form that the child can interpret can be used to exemplarize a linguistic usage of a concept. Thus, the following usages also may be appropriate: "Zots nurse their young," "Zots live in colonies," "Zot females carry their young on their backs."

The set of linguistic usages of the zot concept affords the child a basis for deducing various attributes of zots. In consequence of multiple usages, certain levels of the conceptual hierarchy for zots will be populated by two or more attributes of zotness. Hence, a set of linguistic usages, taken collectively, characterizes zots extensively. The upper bound of such characterization conceivably would be informationally isomorphic with a formal definition of zots.

³How the system will structure criteria for accepting and rejecting interpretations of structures is a complex matter on which consensus has not yet emerged. The question is rather central to language-mediated concept learning because a construction's informational value will increase with each interpretation of the construction that can be ruled out.

All but the most primitive of single-attribute concepts can be expected to grow in some sense over instructional time. Such growth may be in terms of precision, generality, or both. The zot concept is no exception. Each new linguistic usage of the concept invites a change in the conceptual domain referencing to zots. The implication is that everything that could be known about zots belongs to the zot concept (or system), just as everything that could be known about mechanics belong to the mechanics concept (or system).

Definitions and Differentiations

Let us suppose that the child brings to school a concept of animals whose domain is that of the anthropoids and of home, farm, and typical zoo quadrupeds. Thus, the concept domain is interpreted more narrowly than as all fauna and probably more narrowly than as all warm-blooded fauna, all terrestrial fauna, or all vertebrates. Perhaps the domain is that of all terrestrial, warm-blooded, vertebrates, as distinguished from birds, fishes, shelled animals, sea mammals, reptiles, insects, and microorganisms. We can cause the concept domain to grow larger, to signify all fauna, to become differentiated into bovine, canine, feline, etc. genres, or both.

The form of any class is described with a definition that indicates certain critical attributes and how these are related. This would be true at the fauna, genus, or other levels of classification. However, different classes at the same level of classification need not be descriptively differentiated by contrasting their definitions, although that might be the most thorough approach to contrasting same-level classes. Alternatively one might say that bovines are grass eaters and felines meat eaters or that bovines have hooved feet and felines clawed feet. Hence, one may distinguish between linguistic characterizations that specify the domain of a class and those that, being less complete, are consonant with a broader domain interpretation of a class than is (ultimately) intended.

It is likely that the concept of animals that the child brings to school is a narrower one than he will have later on. The concept of cows that he brings to school may be not only narrow but highly stylized. While such a stylized view of cows may reflect the abstracted attributes and relations between them that the cow form-function concept encompasses, the stylization entails exemplarization that fails to portray the diversity of member characteristics that the abstracted view permits.

While the child comes to school underestimating the domains of some concepts and rules, he tends to overestimate the domains of other concepts and rules. Typically, he overestimates the conjugational regularity of verbs.

We will call a characterization that specifies a criterion domain for a concept a definition. A characterization that specifies only part of the information contained in a definition or one that provides information that can be used to differentiate the concept into subconcepts (or the class into subclasses) we will call a differentiation. If the bovine concept is defined as suitably related Multiattribute Concepts A, B, and C and A is the quadruped concept, then "Bovines are quadrupeds" differentiates bovines from some other class or classes--e.g., bipeds--but fails to define bovines. While indicating much about animality and perhaps even something about cattle, descriptions that portray a taxonomy for cattle also are of the differentiation type, since they do not succeed in defining a criterion domain for the cattle concept. Such characterizations for cattle might be based on the following rather common characteristics along which subclasses of cattle may be distinguished: a) sex--e.g., cows, bulls, b) age--e.g., calves, adult cattle, c) age-sex--e.g., heifers, cows, d) sex-linked operations--e.g., bulls, steers, e) other operations--e.g., horned, dehorned, f) function-locale--e.g., milk (dairy) cows, beef (range) cattle, g) breed characteristics--e.g., shorthorned, longhorned, and h) breed--e.g., Angus, Brahma, Charolais, Guernsey, Hereford, Holstein, Longhorn, Shorthorn.

Let us treat the segment as a unit of instruction and define a concept-learning program as consisting of 10 ordered segments. Whether a concept is being expanded or contracted in such a program, it is possible to define a criterion domain for each segment of instruction. Hence, there might be a progression of definitions, one for each segment, with instruction culminating on a program definition. If instruction moves concurrently toward program criterion values for domain specification and for differentiation of the concept, then perhaps at all points in the progression across segments both characterizations that define domain and those that differentiate the domain will apply.

Linguistic Characterization

A characterization is a complete formalism if none of the names of its attributes and relations are interpreted. Degree of formalism of a characterization could be varied. However, characterizations having pedagogical utility probably most usually should be devoid of formalism in the primary grades.

If we seek to define the domain of a concept, then a single usage gives us the least information concerning the domain and a definition the most. Were the task one of training a concept purely on a language-mediated basis, then the characterizations used probably should come from the top of the informational scale--that is, should be definitions. Let us imagine that the zot training program has the following definition as the indicator of the program criterion domain of zots.

A zot is a beady-eyed, fur-covered, ape-like animal, gray-colored, with a grasping tail, pointed ears, protruding belly, long fingers, and clawed feet.

If all names in the definiens component of the definition can be assumed interpreted consonant with pedagogical interest, then the definition conveys a good deal about zots. Note that the only clue to how the various attributes of zots are related is furnished by the item "ape-like." If ape is suitably interpreted and the linguistic concept N-like is properly understood, then the definition provides a basis for integrating the various attributes of zots into a representation of a zot.

The design of a zot program essentially involves providing a learning hierarchy for reaching the criterion zot domain as this is defined above. Enroute proficiencies of such a hierarchy will depend in part on whether the instruction is primarily inductive--based on real-world exemplars of zots or zot parts--or primarily deductive or a mix of the two.

Type of Learning

Learning the zot definition presented above is an associative learning task. However, the lexical constructions employed in the definiens name previously-learned real-world concepts. Thus, the associatively-learned definition does no more than relate subordinate concepts.

Does zot name a concept and, if so, is the concept learned? Inductive concept learning involves presenting a set of real-world exemplars of the concept during training. During testing for concept learning, the child is required to construct or to select from a set of positive and negative instances--none of them used during training--the positive or zot instances. In the deductive, or language-mediated, training situation, zots are not real-world exemplarized. In this situation, the inductive basis for learning the concept is pushed back one or more steps to the attributive level, since the attributes will have been learned as concepts during earlier training using the inductive approach.

Constructing zots would confound the child's drawing skill with his concept learning. Hence, selection of positive instances seems the apt test when the drawing requirement is appreciable.

If one or more of the attributes of zots are class terms reflecting diversity, then the artist will be able to produce a set of positive instances of zots which, however, show some diversity. Negative instances would exemplarize apes. Perhaps these should be colored gray. (While not one-valued, gray's range is narrow. Showing all instances as gray removes the color attribute from a

test for zot concept learning.) If the concept is learned, then the child will sort the positive and negative instances into two different piles with few misclassifications. (The amount of training that will insure this depends on how similar negative and positive instances are.)

Concluding Remarks

Language-mediated concept learning presumes a) the prior learning of a range of subordinate real-world concepts, based primarily on induction, b) the association of a lexical construction that names the concept with each of the subordinate concepts, and c) skill in interpreting the linguistic system that is sufficient to permit a linguistic characterization of a concept to be decoded to real-world significance as an integrated representation of subordinate concepts.

Grammar finds its place in a curriculum as a sufficient response to the interpretation requirements underlying decoding linguistic characterizations to real-world significance. If there are exploitable characteristics of the linguistic system that are maturationally-bounded, as is probable, then linguistic characterizations that involve understanding these characteristics will need be avoided until the child is maturationally-prepared to handle them.

The to-be-learned concepts specified, it should be possible to define the kind and order of grammar treatments, consonant with maturational considerations, that will be apt to the learning of such concepts. Within such a framework, one would use the real-world conceptual domain as a basis for hypothesizing grammar treatments that might facilitate concept learning and effects of these treatments on the learning of appropriate concepts as a basis for accepting or rejecting the treatments.

Properly staffed, the language mediation process probably can be explicated ex cathedra a good deal better than it has been in foregoing remarks. Given a suitable body of concepts, it should also be possible for such a staff to preliminarily design grammar instruction that comes much nearer to being relevant to primary education than are any current such treatments--whether those that are used in the schools or in psycholinguistic studies.⁴

⁴This paper was drafted just as the media were picking up the enthusiasm of proponents for a voucher system of education. The advocates of voucher systems would have the parent shop around for a school for his child. Beyond that, they would mandate to the parent the choice whether skills to be acquired were those of yoga, elocution, or serendipity. There is something to be said both for the free market idea and for a limited free choice among electives. My response beyond that is contained in the generally-prescriptive spirit of the paper's remarks.